THURSDAY, OCTOBER 23, 1919.

FACTS AND FACTORS OF EVOLUTION.

The Causes and Course of Organic Evolution: A Study in Bioenergics. By Prof. John Muirhead Macfarlane. Pp. ix+875. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) Price 17*s.* net.

THIS book is the outcome of a lifetime of biological reflection and investigation, and will be read with much interest. The author, who left Edinburgh for Philadelphia many years ago, was early disciplined in zoology, as well as botany, but it is to the latter that he has especially devoted himself as professor in the University of Pennsylvania. His treatise is erudite and careful, very instructive, even apart from its theories; it expresses the convictions of a patient and independent thinker; it states a number of piquant conclusions more or less peculiar to the author; and it is carefully written. It covers a very wide range—the origin of organisms upon the earth, the phylogeny of plants and animals, the evolution of morals and man, the ethical factor in organic evolution, the rôle of religion in the ascent of man, the competitive and the co-operative systems among animals and in mankind, the human environment as it has been and is, and the evolution yet to come. We must restrict our attention to a few of the salient features.

(1) Prof. Macfarlane notes that "energy, continuity, and evolution," which may be said to constitute "the triune basis of existence," form the keynote of his book. But all that is distinctive is the prominence given to "energy." The author recognises a series of forms of energy, which he calls thermic, lumic, tonic, chemic, molic or gravic, electric, biotic, cognitic, and cogitic. Biotic energy is associated with protoplasm in general, cognitic with chromatin, and cogitic with neuratin or Nissl substance. The terms "cognitic" and "cogitic" are far from happy, and it is of dubious utility to apply the physical concept of energy to certain aspects of vital activities which remain undescribed when a physical and chemical formulation has been given of the others. If it could be definitely stated—as it cannot—that the particles which ultra-microscopic examination shows in movement in a living nerve-cell are associated with a particular kind of energy, distinct from and yet in a line with such recognised energies as heat and electricity, then there would be an objective basis for a form of positive vitalism, similar to that held by some modern biologists, such as Prof. Marcus Hartog and the late Prof. Richard Assheton; but more evidence of the reality of "biotic energy" is required than Prof. Macfarlane adduces—more evidence than the usually admitted inability to give an adequate description of the most characteristic features of the activities of living creatures in physico-chemical terms. The living organism is a riddle imperfectly read, but our confidence in Prof. Macfarlane's contribution is not increased when we find two or three more particular forms of energy piled on the top of biotic.

(2) The author has discovered, he thinks, overlooked factor in organic evolution, which he calls proenvironment—"the resultant response of an organism to the sum-total of all the environal agents that act on it or on any part of it, and which causes the organism to proenviron a course or pathway that is temporarily *satisfying* to it, and that can alone be taken in virtue of the action of the several environal agents, and the reaction to each of these by appropriate organismal molecules." More briefly, Prof. Macfarlane defines the "law of proenvironment" as "the correlated resultant response by any body to the summated correlation of stimulatory action, that leads to a temporarily *satisfied* state." We rub our eyes; the so-called law of proenvironment takes us back to Herbert Spencer (with his emphasis on equilibrium and "effective response") and farther. Surely it is a commonplace that the lines taken by development and activity alike are resultants of environmental stimuli acting on living organisation which is internally determined by the inheritance and by previous experiences so that its responses are on the whole adaptive. We confess that we see very little in Prof. Macfarlane's discovery, and we doubt whether the capacity of giving a more or less satisfying unified response to a variety of external stimuli is a factor of evolution at all, except in the sense that every organism is a factor in its own evolution. It is a fundamental fact of life. The "five organic factors that are form-producing," the co-operative action of which is "pentamorphogeny," are Heredity, Environment, Proenvironment, Selection, and Reproduction. But there would have been heredity, environment, proenvironment, and reproduction though there were no evolution, and what would Darwin say to leaving Variability out of the Pentarchy?

(3) The author contends vigorously that "the main and dominant lines of animal evolution have all originated in fresh water or on land, and that only side lines have assumed a marine life, though these have often branched out profusely into species, and even have given off again groups that have in rare cases returned to a fresh-water or a land life." This is a good-going heresy, and the author supports it with learning and ingenuity. It is directly counter to the conclusion of most authorities, who hold that the probabilities are in favour of a marine origin of most of the phyla. Prof. Macfarlane makes out such a strong case that we feel how uncertain these speculative conclusions are. In our ignorance of the actual beginning of most of the phyla it is difficult to prove the erroneousness of the view that the buds were in fresh water, though the blossoms may have been in salt. We submit, however, a few considerations:

(*a*) At this distance of time appeals to present-day numbers of fresh-water and marine species in any particular phylum cannot be

of much value in reference to origins, but there is some utility in thinking of the numbers of types in the two habitats, and of cases where the enormous majority of the types in a phylum are in the one or the other. Now, if we begin with the lowest phyla of Metazoa, the Sponges and Cœlentera, we find in both cases the vast majority of types in the sea and a very small minority in fresh water. The most natural—though not inevitable—inference is that the present-day habitat of the vast majority is the original habitat. The Echinoderms represent a well-defined phylum, all the living representatives of which are marine. The types at the base of the Chordate phylum—namely, Enteropneusts, Tunicates, and Lancelets—are all marine, which is again significant. Many similar cases might be given, but Prof. Macfarlane advances counter cases, and actual demonstration is out of the question.

(*b*) If we take a number of notable advances, such as paired unjointed limbs or parapodia, such as body-segments or metameres, such as genuine pre-oral appendages, such as the annulate or the chordate type of nervous system, such as true gill-clefts, such as a dorsal axis, and ask where they began, the evidence from present-day forms and from palæontology is on the whole in favour of the answer: In the sea. But Prof. Macfarlane brings forward counter instances, and no doubt the fresh waters have been a very educative school of life.

(*c*) Types with direct life-histories are very generally, though not always, less primitive than related types with larval stages, and the tendency of fresh-water animals to have little in the way of larval stages (telescoping these, according to our theory) is very striking except along a few lines, such as that of aquatic insects, which are no doubt primarily terrestrial. And it is not difficult to see why it should be so.

(*d*) For most of the types of fresh-water animals it is possible to give a plausible pedigree, starting from marine or terrestrial forms.

(*e*) It is a significant fact, emphasised by Quinton, that the blood of land animals, such as mammals, is in the proportion of sodium, potassium, and calcium ions almost identical with sea-water. It is difficult to interpret this except as a hint of pedigree.

(4) It is impossible to do justice in a few lines to Prof. Macfarlane's long discussion of the phylogeny of animals. He regards Rotifers—in spite of the specialisation of most of them—as "the foundational group" of the simpler Metazoa, and he has the hardihood to place a ciliated Infusorian and a Rotifer side by side, for "the lines of stereogenesis in the Rotifera remain fundamentally as in ciliate Infusoria." We do not profess to know much about stereogenesis, but the juxtaposition of a Rotifer not only with an Infusorian, but also with a larval Entomostracan and a larval Gastropod strains our morphological faith. It must be a foundational creature indeed which is like three things so different. The author traces the main line of ascent from the Rotifers through Turbellarians, Nemerteans, Cyclostomes, Cæcilians, to Marsupials and higher Mammals. The difficulties involved in side-tracking Tunicates and Lancelets and in dragging Cyclostomes and Cæcilians on to the direct line of ascent seem to us to be insurmountable. But this is largely a matter of opinion. It seems to be truer of phylogeny than of statistics that if you pick your data you can prove anything you like. There are, naturally enough, some loose ends in Prof. Macfarlane's arguments. These are of two kinds—matters of fact, as when he says that the eggs of Cyclostomata undergo holoblastic segmentation, which is not true of Myxinoids; and matters of interpretation, as when he says of the Cæcilians: "the active gliding habits and slippery skin, also, scarcely serve to set up the needed irritable stimuli that would start paired limbs as a response-result." This surely verges on the poetical.

(5) A useful chapter on "higher" animals expounds the not unfamiliar idea that along different lines and at different structural levels animals rise to approximately equal complexity of behaviour. Thus octopus, spider, ant, crow, and elephant are types that rise high along different lines of structural advance. This is sound enough, though it is time that Sir Ray Lankester's distinction between the "little brain" and the "big brain" types of cleverness was recognised in all such comparisons, but what seems to us quite in the air is Prof. Macfarlane's theory that the "energising stimuli" of a complexified environment excite the biotic system of the body and the cogitic cells of the brain to new adjustments and adaptive changes, "all of which are more or less shared by and influence the generative cells, which in turn affect the succeeding organisms hereditarily." In other words, without any submission of evidence, we are asked to return to the credulity of Lamarckism. The author says: "To repeat once more our fundamental position: flows of energy, often and steadily repeated from sense-collecting centres, start stereo-energetic stimulation-acts, that inevitably affect the brain-cells, and these by expenditure of cogitic energy give rise to proenvironal responses that constantly tend to place the organism for the time being in 'satisfied' relations to its environment." In so saying he seems to us to be stating with unnecessary technicality the fact that living creatures adjust themselves within limits to their surroundings; but when he suggests that the elephant's trunk evolved by the transmission of the results of individual "proenvironal reponses," we feel bound to say "napoo."

(6) In regard to the Ascent of Man, the author lays emphasis (as Anthony, Wood Jones, and others have done) on the evolutionary importance of the emancipation of the hand which "stimulated the brain to increased flows of energy and so increased complexity and growth." "In all such advance by environal stimulation-action and brain reaction, followed by proenvironal outreach-

ing and succeeding response, the great law of proenvironment is constantly at work." Again, we have the same fallacious hysteron proteron. Surely the emancipation of the hand was the outcome of variations of structure and habit which are left unexplained (not that *we* can explain them); surely the cerebral initiative that put the free hand to manifold tests and found for it a thousand uses was and is a cause, not a consequence; moreover, the hereditary entailment of individual gains is a hypothesis, not a proven fact. We wish to make clear that when Prof. Macfarlane speaks of "the capacity of an organism for perceiving and then positively growing or moving toward an environment that is most satisfying for it," he is not defining any new "law of proenvironment," but referring to the fundamental fact that the organism is a self-preservative agent. In so far as other evolutionists have forgotten this and made the organism a passive pawn in a game, or a portmanteau of potentialities which require only liberating stimuli, Prof. Macfarlane's thesis is of great service. He has hold of the open secret that the organism shares in its own evolution.

(7) Our admiration is commanded by the two chapters in which the author gives an appreciation of the two great ways—competitive and co-operative—in which organisms answer back to the difficulties and limitations that beset them, though we do not think he realises what Darwin clearly expressed, that a co-operative reaction to a crisis is as much part of the struggle for existence as a competitive one. We wish that we had space to refer to the concluding chapters on human evolution, which are marked by a splendid earnestness and a truly evolutionistic hope. We can only refer to the cope-stone of Prof. Macfarlane's hierarchy of substance. Just as biotic energy is associated with protoplasm, cognitic energy with chromatin, cogitic energy with neuratin, so there is "spiritic energy"—a still more condensed mode—which "has so functioned as to energise the more aspiring and lofty souls of humanity to widest outreachings, toward the most profound questions of the world and the universe." "The phenomena, the experiences of human life in the past millennia especially, powerfully suggest to the writer that built up on, energised by, linked into complex relations by, a combined bio-cognito-cogitic union is a still more complex substance than the protoplasmatin, chromatin, or neuratin, probably resident in some part of the gray frontal matter of the brain, and which hypothetically we may call the *spiritin*." No man understands his brother's philosophy, and we do not know what Prof. Macfarlane is getting at by his quaint and uninviting system of substances and energies. There may be some, however, to whom it makes the riddle of the organism—body-mind and mind-body—clearer; and we are sure of this, that there are facts enough in the volume to reward even the learned, and that the whole work is marked by resoluteness and sincerity.

J. A. T.

AMERICAN UNIVERSITIES.

(1) *The America of To-day. Being Lectures delivered at the Local Lectures Summer Meeting of the University of Cambridge*, 1918. Edited by Dr. Gaillard Lapsley. Pp. xxv+254. (Cambridge: At the University Press, 1919.) Price 12*s.* net.

(2) *The Voyage of a Vice-Chancellor.* Pp. ix+139. (Cambridge: At the University Press, 1919.) Price 6*s.* net.

(1) THIS volume of lectures delivered at Cambridge in the summer of 1918 contains only two chapters of direct technical interest to the readers of NATURE—namely, that of Prof. J. W. Cunliffe, on "American Universities: their Beginnings and Development," and that by Dr. G. E. MacLean on "State Universities, School Systems, and Colleges in the United States of America." The first of these gives a very interesting account of the English origins of American universities, of the effect of the different environments in bringing about a gradual departure from the English model, the injection of German influence, and the subsequent growth along more independent lines. The similar process of development is traced by Dr. MacLean with respect to the State-supported institutions, which have no direct counterpart in Great Britain. A very clear account is given of the various ways in which State and federal subsidy is provided for these institutions, and there is a brief discussion of the type of administrative organisation which has grown up. Both Prof. Cunliffe and Dr. MacLean rightly emphasise the ideals of universal education which have led to such a large expenditure of public money upon the school system as a whole. The result is, perhaps, that the reader unfamiliar with the situation would get too rosy a picture of the state of affairs. Not that there is any loss of faith in the ideals, but that, as Dr. MacLean points out, there is a strong feeling that great changes of method are necessary, and, indeed, such changes are constantly under discussion and under trial. Though they have no direct bearing on the subject of education, chaps. iii. and iv., by Lord Eustace Percy, on "State Municipal Government" and "Social Legislation," read in conjunction with those on education, will give a fairer idea of the tremendous problems presented by education in America and of the political and social difficulties involved in their solution.

(2) Such an important journey as that of the British University Mission in the autumn of 1918 to Canada and the United States will doubtless be the subject of formal and formidable reports both in England and America, but it is well to have also such an intimate and clever personal record of daily happenings as Dr. Shipley has given us in this volume. Though the account, in diary form, is very brief, one gains a clear impression of the differing characteristics of the various institutions and regions which were visited. As one reads of the unbroken series of banquets and

luncheons to which the commission was ruthlessly exposed, the number of speeches which they were forced to make, and the other at least equal number to which they were compelled to listen, one is impressed by the fact that this academic group "did their bit" in a very real sense. One also wonders whether the present demand for a reduction in the hours of labour could not be directed towards a change in the customs of after-dinner speaking, resulting in a great conservation of the nervous energy of the world. It is to be hoped that the journey which is here so gracefully described is but the first of many, perhaps less formal but more leisurely, which will be undertaken by academic and scientific men of both countries. It would be a pity if the greater intimacy and understanding, which war conditions have undoubtedly brought about between the men of science of England and America, should for any cause be allowed to lapse. C. E. M.

OUR BOOKSHELF.

The Statesman's Year-book. Statistical and Historical Annual of the States of the World for the Year 1919. Edited by Sir John Scott Keltie and Dr. M. Epstein. Fifty-sixth Annual Publication. Revised after Official Returns. Pp. lii+1476. (London: Macmillan and Co., Ltd., 1919.) Price 18*s.* net.

ONE turns to the new volume of this ever-welcome annual with considerable interest in view of the present fluid condition of international affairs. The coloured map shows the condition of Europe in June of this year, the accession to political sovereignty of Iceland, Poland, and Czecho-Slovakia is recognised by their treatment in new and separate sections, and the introductory pages contain the League of Nations Covenant, a summary of the peace terms to Germany, and a continuation of the diary of the war. The Iceland section summarises the consequences of the Act of Union of November, 1918, which makes the connection between Denmark and Iceland, in other than certain temporary arrangements, entirely due to the fact that both States have the same King. Although it has not been possible to include statistics regarding the dismembered Austro-Hungarian Empire, various estimates have been included—*e.g.* the new Austrian Republic has a population of some ten millions, of whom 90 per cent. are Germans; the probable population of Yugo-Slavia is twelve to thirteen millions. There are brief summaries of the results already achieved by British administrators in Mesopotamia, and of the newly independent kingdom of Hejas.

The Boys' Own Book of Great Inventions. By Floyd L. Darrow. Pp. ix+385. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1918.) Price 12*s.* 6*d.* net.

THIS book contains a popular and interesting account of the more important inventions of the last hundred years. One chapter is devoted to the gyroscope; six to telegraphy and telephony, with and without wires; two to aviation; and one each to the submarine; the steam engine; petrol, oil, and gas engines; the use of machinery in agriculture; the development of electricity; the evolution of artificial illumination; fire and high temperatures; some notable achievements in chemistry; the story of iron and steel; and Galileo and the telescope. The treatment is unusual. The author in most cases first appeals to general interest by describing practical achievement. He then gives an account of the theory, and concludes with a few experiments which the boy may perform for himself.

The style is good, the information is accurate, and the explanations are generally clear. The experiments are to the point, but, appearing as they do detached from the descriptions of the apparatus and process, they appear to be scrappy and unsatisfactory. Many of them are quite unnecessary in the case of a boy who is doing science at school, and to a boy who is not they would not all prove helpful. We prefer description and explanation, even where that involves experiment, to be more closely associated.

The value of some of the half-tone blocks is much reduced by printing two or three on a page, which renders them indistinct.

Apart from these minor defects, the book is first-rate, and will form an excellent gift for a boy who is interested in scientific achievement.

E. C.

Interpolation Tables or Multiplication Tables of Decimal Fractions. Giving the Products to the Nearest Unit of All Numbers from 1 *to* 100 *by* 0·01 *to* 0·99 *and from* 1 *to* 1000 *by* 0·001 *to* 0·999. By Dr. Henry B. Hedrick. Pp. ix+139. (Washington: Carnegie Institution of Washington, 1918.)

THE simplest description of these tables is to say that they give such results as $0{\cdot}302 \times 441 = 133$ with the certainty (barring errors in the tables) that the third digit in the product is correct. Taking out such a product from the tables is an easy operation, requiring very little time; probably, with practice, the use of the book would be as expeditious as that of an ordinary slide-rule, and the results more trustworthy.

Various other ways of using the tables are explained in the introduction. The editor also gives interpolation formulæ, and worked applications to astronomy, etc., in which these tables are used.

This publication appeals to a large body of computers and scientific workers, and affords another instance of the wise enterprise of the directors of the Carnegie Institution. They have already earned the gratitude of arithmeticians by their tables of primes and factors, and they are doing a public service by thus undertaking the cost of printing works at which no ordinary publisher would look for a moment.

The printing and arrangement of the tables seem to be all that could be desired.

G. B. M.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Doubly Refracting Structure of Silica Glass.

I HAVE recently observed that "silica glass" possesses a remarkable crystalline or quasi-crystalline structure when examined in the polariscope.

The double refraction is extremely weak, the retardation being probably of the order of 1/10000th of a wave. The structure cannot be advantageously examined with a polarising microscope as used by geologists, for the large number of lenses between the Nicols show enough double refraction to spoil the contrast between the dark and light parts. It is advisable to use a Nicol, and not a glass reflector, as polariser, and to dispense with lenses between the Nicols. A magnifier of 2 in. focus is placed above the analyser. An extremely bright light is necessary; I have used sunlight reflected straight into the apparatus, thus obtaining an intrinsic brightness comparable with that of the sun's disc. (No doubt an arc with a suitable condenser would do equally well.) The Nicols are to be accurately crossed so that the sun is invisible.

If a circular plate of fused silica of "ordinary" quality with polished faces is examined in this arrangement, it shows a striking mosaic of dark and bright parts without regular arrangement. The size of this structure is of the order of half a millimetre. It is seen superposed on the ordinary "dark cross" due to strain, which extends across the whole disc, 6 cm. in diameter.

A rectangular plate of the same class of material showed the dark parts elongated into bands set in a definite direction, and suggestive of a flow structure.

A circular disc of optical quality silica showed a spiral structure.

I have examined a large number of specimens of sheet- and bottle-glass without meeting with any trace of such a structure, which is evidently something quite peculiar to silica glass. It may be suggested tentatively that silica glass consists of a mass of "liquid crystals" comparable with those described by Lehmann in the case of certain organic substances.

It is intended to obtain photographs of these structures, and to study the effect of heat treatment on the silica until it becomes visibly devitrified.

RAYLEIGH.

Imperial College, South Kensington,
October 20.

A Search for Fine Wool.

MR. LYDEKKER in his monograph on "Wild Oxen, Sheep, and Goats," published in 1898, stated that the ancestral stock of sheep is not only extinct, "but totally unknown." But in a book on sheep published in 1912 Lydekker admitted that the mouflon and urial had probably contributed to the making of domestic breeds. As a matter of fact, it has been proved beyond doubt (1) that the first domesticated sheep in Europe (*i.e.* the sheep introduced by the Alpine race about 7000 B.C.) were derived from a urial (*Ovis vignei*) not unlike the one now inhabiting the Kapet-Dagh, and (2) that nearly pure descendants of the ancient Neolithic breed still survive on the small uninhabited island of Soay (Sheep Island) near St. Kilda. Further, it is now realised that rams of at least three varieties of *Ovis ammon* have long been used for maintaining the size and vigour of fat-rumped and other breeds of Central Asia. More important still, it has recently been ascertained that the wool forming the inner coat of several of the wild sheep of Asia is longer than in the Soay, and decidedly finer than and quite as white as superfine Australian merino, usually said to be the finest and whitest wool in the world. Crosses between Soay and Southdown sheep yield excellent mutton, and beautiful wool remarkable alike for its strength and quality.

It is hence possible that, with the help of the urial and other wild types, new fine-woolled, vigorous varieties of the merino might be introduced. In the meantime, I am anxious to examine the wool of crosses which include wild species amongst their recent ancestors. Sir Joseph Banks, president of the Royal Society when the attempt was made to establish the merino breed in England, was a keeper of sheep, and was "well informed on all points relating to the production and uses of wool." Some of the readers of NATURE who, like Banks, are interested in sheep may be in a position to help in the new search for the Golden Fleece.

J. C. EWART.

The University, Edinburgh.

Radiation Temperatures.

IN a letter to NATURE of October 9 (p. 113) Mr. Mallock points out the uncertainties attaching to records of "temperatures in the sun," due to the influence of the nature of the thermometer bulb on the readings. Similar uncertainties attach to readings of instruments exposed to a clear sky at night, and with even greater force, for there are two main radiation factors here, one of them being the cold ground—such thermometers being generally placed only four inches above the soil—and radiation to the ground is dependent to a very large extent on the nature and condition of the soil, or of the vegetation growing on it. It would appear that the so-called minimum earth radiation temperatures have very little value as meteorological data. Both these and readings of "temperatures in the sun" are affected by a source of error other than that noticed by Mr. Mallock, namely, the size of the thermometer bulb. With very large bulbs this may not obtain, but with bulbs of ordinary dimensions, say from 1·2 to 0·2 c.c., the difference caused by size is very noticeable, and is a curvilinear function of that size; with still smaller bulbs the function becomes rectilinear, the apparent radiation effect varying inversely with the linear dimensions of the bulb. Within the limits of bulb-size above mentioned, the differences observed may be 5 to 10 per cent. of the total radiation effect; and this, with readings "in the sun," might represent differences of 3° to 6° F. These figures apply to mercury thermometers; I have no observations yet with alcohol thermometers.

Differences of radiation temperatures due to the size of the object have an important bearing on subjects other than meteorological records. Thus, it will be impossible to cool a very small object by radiation to a temperature appreciably below that of the surrounding medium; hence the damage done to the pistils and stamens of flowers by frost cannot be due to radiation, but must be the result of the coldness of the air about them; therefore, methods of protection from frost dependent on preventing radiation by interposing a smoke cloud, or smudge, between the tree and the sky, will be ineffective, unless, indeed, the smoke cloud is sufficiently extensive to cover a large tract of country, and thus ensure a material reduction in the loss of heat from the ground by

radiation, and a consequent reduction in the cooling of the air above it. Local and restricted smudging will not prevent the inflow of colder air from the surrounding land where radiation is active.

In England and on the Continent most of the recent suggestions for frost-fighting have been erroneously based on smoke production; but in Canada and the United States, although the reason of the inefficiency of smoke production does not seem to have been realised, the steps actually adopted for frost-fighting have taken the right direction, aiming at orchard heating—that is, actual heating by artificial means the air and the trees in the plantation. It is true that smudging is still used, but with a very different object, the smudge fires being lighted at dawn to prevent the sun's rays from heating too rapidly the frozen blossoms. It appears that the damage usually done by frost is not due to the freezing of the contents of the cells and the disruption of the cell-walls, but to the freezing of the intercellular liquid, the formation of ice here resulting in the abstraction of water from the cells; on thawing, this water is re-absorbed, but only very gradually; and, if the heating be too rapid, much evaporation occurs before the re-absorption is complete, and the cells remain permanently depleted of part of their water. The dehydrating action of freezing water in this case is analogous to that observed by the present writer in the case of clay and other highly hydrated substances, when the liquid in which they are suspended is frozen. But in those cases no re-absorption of the water occurs on thawing.

SPENCER PICKERING.

Time Relations in a Dream.

THE following account of a dream which I had last night, and of which I took some notes, may be of interest. The dream commenced by my, as I thought, hearing a drop fall on the laboratory floor; after a time there was another drop. I then realised that mercury was dropping on the floor from a small split in some rubber tubing in a gas-analysis apparatus. As I became more wakeful and seemed to realise that I must get up to deal with the leak, the drops fell more rapidly until they were coming quite fast at the moment when I definitely awoke. I then realised that the dropping of mercury which I heard in my dream was in reality the ticking of the clock in my room.

The point which interested me, and may, I think, interest you, is that of the time relations of the dream. I went over my memory afterwards with a stop watch—and, of course, it is only one's memory of a dream that one ever has to go upon—with the following results:—

As I dreamed it, the interval between the first two drops seemed to be of the order of five seconds, and the drops seemed to quicken until they were at an estimated rate of about one drop per second.

Now the actual rate of ticking of the clock was one tick every quarter of a second. It is, of course, evident that one's judgment of time in a dream is quite erroneous in the sense that the occurrences as they take place in the dream seem to extend over a much longer time than the actual time of the dream.

On the assumption that each consecutive drop in my dream corresponded with one consecutive tick, it would appear that at the commencement of the dream the time interval between two consecutive ticks was exaggerated about twenty-fold in the dream, and that as I got more nearly awake the degree of exaggeration became reduced to something like four-fold. At a guess, I heard about thirty drops, in which case the dream would have lasted seven to eight seconds.

There is another possible interpretation, namely, that when I was most soundly asleep only one tick out of twenty came through to my consciousness, and that as I became more wakeful the number increased until one tick in four came through. On the latter theory the dream would have lasted considerably longer than on the former.

Whatever the interpretation, however, it occurred to me that the time records might be of interest, as a dream is rarely so simple or of such a kind as to admit of even the vague degree of measurement which I obtained.

JOSEPH BARCROFT.

Physiological Laboratory, Cambridge, October 14.

International Relations in Science.

A CIRCULAR letter has been addressed, within these last few days, to "Members of the Academies of the Allied Nations and of the United States" by their brethren of the learned societies of the neutral countries. It is an appeal for toleration, even for generosity, an earnest and eloquent protest against a policy which would seek to exclude the present generation of German scholars and men of science from all our scientific and scholarly intercourse.

I cannot say that I have always been on the side of tolerance and reconciliation; but already we have had some little time to think, and this all but cosmopolitan appeal is bound, as it seems to me, to become a factor in the case. It is signed by very many friendly and honoured names; we cannot shut our ears to it, we cannot resolve upon isolation, lest it be isolation indeed.

This is not a matter to be decided for us by the votes of others, but by each man for himself—by all who claim liberty of action and freedom of thought. I am convinced that very many men feel, as I feel, that whatsoever overtures our German-speaking colleagues may make to us on matters scientific should be freely reciprocated. Need we ask what a man has thought or said, or even what he has done, in these last sad years? If he come in the universal name of science let that suffice; let it be granted that he means, now and henceforth, to follow the paths of learning and to walk in the way of peace.

St. Andrews. D'ARCY W. THOMPSON.

INTERNATIONAL ORGANISATION IN SCIENCE.

AN appeal addressed "to the members of the Academies of the Allied Nations and of the United States of America" and signed by a number of scientific and literary men in neutral countries has been circulated and has already given rise to comments in the Press. It deals mainly with the formation, by the Allied academies, of new international scientific associations which neutral countries are now invited to join. Stripped of its rhetorical clothing, the document is an appeal to let bygones be bygones and to allow science to become again "the great conciliator and benefactor of mankind."

There will be much sympathy with the arguments used, the regrets expressed, and the hopes foreshadowed by our neutral friends, but they have left untouched, and to a great extent misunderstood, the principal considerations which have driven the allied academies to the policy they have adopted. It is only that part of our

scientific activity which involves a regular personal and intimate relationship between men of different nationalities that is affected by the action of these academies. The question, therefore, simply resolves itself into this. Is it possible that an international scientific meeting in which the belligerent countries sit side by side can, at the present moment, lead to any satisfactory results, or tend towards that reconciliation which the neutral countries very naturally and legitimately hope for? There can be but few who will answer that question in the affirmative, and it is doubtful whether those few would include anyone who has had experience of international meetings before the war. The questions discussed at these meetings frequently touch national interests or national ambitions, be it only a discussion whether units adopted in one country shall be universally accepted. It often requires tactful leadership and a conciliatory disposition on the part of everyone present to steer an international meeting to a successful issue.

The matter is, to a great extent, decided for us by Article 282 of the Treaty of Peace which Germany has ratified. According to that article, "treaties, conventions, and agreements of an economic and technical character" not included in a specified list cease to be operative. That this article was intended to cover conventions on scientific matters appears from the list of exceptions, in which the Metric Convention and the Agricultural Institute at Rome are included.

In view of the strong feelings of resentment which still exist between the belligerent nations, feelings shared by the great majority of their members, the alternatives possible to the allied academies were either to discontinue international unions or to proceed as they have done. The former course, not perhaps very harmful in some branches of science, would have been fatal in others, and in coming to a decision they have had to give the foremost consideration to the interests of science. It is intelligible that, both in the review of the past and in the outlook of the future, neutral opinion should differ from ours; but we may be confident that the academies of the nations to which the signatories of the appeal belong will, in considering the invitations which are to be sent to them, be guided in their response by the same interest for the future of scientific progress which lies at the heart of the allied academies.

EVOLUTION OF OSTRICH PLUMES.

PROF. J. E. DUERDEN has published (Bulletin No. 7, 1918, Department of Agriculture, Union of South Africa, pp. 39, 12 figs.) a fourth report on his breeding experiments with ostriches at the Grootfontein School of Agriculture. His work is full of interest, both theoretically and practically. Birds brought from Nigeria have 33–39 first-row feathers on each wing, with an arithmetical mean of 36·54. If these imported birds represent a pure line, the likelihood is that the numerical variations are fluctuating somatic modifications, and that no amount of selection will increase the average number of plumes beyond that given. If the imported birds represent a mixed population of several pure lines, only appearing pure as a whole because of their small differences, it should be possible to obtain higher averages by always selecting as breeders the birds giving the highest number of plumes.

It turns out that Cape birds have the same number of plumes as the wild Nigerian birds, and it appears, therefore, that during the fifty years of ostrich farming in South Africa no advance whatever has been made on the number of plumes originally present on the wild bird. For farmers have always bred for quality; quantity has never been taken into account. As regards the number of plumes, ostrich-breeding has been carried on altogether indiscriminately, and no advance has been made.

Among the Cape birds in the Grootfontein flock there have been two cases of 42 plumes to the first row. One of these met with a fatal accident; the other bred true. The 42-plumed bird might be regarded as a novel mutation, but there is a more plausible view. Recent studies on the ostrich afford strong evidence that the wings of its ancestors were much better covered with feathers than is the case to-day. There has been retrogression, and it is still continuing. The 42-plumed wing is a survival of an ancestral condition. Very interesting facts are communicated in regard to the retrogressive or degenerative processes which are still going on in the ostrich's wing. The retrogression proceeds in one part of the wing quite independently of the other parts. Thus, apart from the plumes altogether, the third finger shows retrogression. It is almost buried in the flesh, and the claw which some books describe has never been found on the hundreds of birds coming under Prof. Duerden's observation. But a study of the plumes lends no countenance to the common view that degeneration takes place by slow, continuous stages. There may be the full presence of particular plumes in one individual, and their total absence in others; but there is not a gradual passage from full expression to the vanishing-point. The degeneracy of an organ may stop at any stage according to the number of constituent factors which happen to be lost. We are apt to think of the degeneracy as a somatic affair, whereas it is germinal.

As to the possibilities of the 42-plumed survival, no chicks have yet been produced from the 42-plumed cock mated with a hen with the same number of plumes, for no hen has been forthcoming. But a score or so of chicks have been reared from the 42-plumed cock crossed with different 36-plumed hens, and these showed an interesting series of numbers from 37 to 43. It seems probable, therefore, that if the 42-plumed

cock had been mated with a 42-plumed hen there would have been a full 42-plumed progeny. If similar 42-plumed survivals occur, it should be possible for farmers to increase by as much as 25 per cent. the crop of feathers from the same number of birds, or, a more desirable outcome, to procure the same quantity of plumes from three-quarters of their present number of birds. Prof. Duerden is to be congratulated on reaching conclusions at once of high theoretical interest and great practical utility.

EDUCATION IN INDIA.[1]

THIS is the second quinquennial review compiled by Mr. Sharp, Educational Commissioner with the Government of India. Shortage of paper and other conditions bred of a period of war have compelled him to curtail his report and, not without advantage, to diminish his statistics. What remains is full of interest and significance, especially, of course, to those who have some first-hand knowledge of Indian education. There is the inevitable, and in some respects useful, comparison with the educational statistics of various European countries and Japan. Of this it is necessary to repeat that the comparison is obviously unfair, even in the case of Japan. British India is a continent rather than a country, and is far more varied in culture and civilisation than Europe or Japan. It is the great towns, such as Calcutta or Bombay, that should be compared with European countries, since there alone are conditions sensibly similar to those of Western nations.

We should have welcomed, too, a fuller account of the attempts to impart instruction in the local languages. So long as British rule exists it will be as necessary for Indians to learn English as for educated Englishmen to learn French and German. But English as a medium of instruction is open to obvious objection. We continue to hear complaints of superficial thought, parrot learning of cram text-books, absence of originality, and so forth. Surely this is largely due to making lads, many of whom are not gifted linguists, learn difficult subjects, such as science and mathematics, in a language in which they cannot think. Were it not that many Indians have attained to a surprising proficiency in English, the system would have been condemned long ago. In the chapter on Oriental teaching Mr. Sharp confines his remarks to education in the Indian classics, and has little or nothing to say of the attempts now being made to gain for the modern languages of India the same facilities that English universities are now supplying for European living speeches, their philology, phonology, and literature.

From the point of view of education in India, war and the economies it involved came at an unfortunate moment, since it was necessary to suspend a great part of the reforms projected in Lord Hardinge's resolution of 1913. Even in that circumstance, however, we may ultimately find comfort, since what India chiefly needs is not official encouragement and the vicarious liberality of Government so much as public appreciation of what good and solid education is and by what means it can be supplied to the people at large. One of the most important steps in this direction (less neglected than official reports seem to show) is to make the greater Indian languages fit vehicles for supplying instruction to immature minds. In many Indian provinces non-official committees and societies have carefully compiled vocabularies of scientific terms. Some of these seem pedantic and clumsy enough to those who study Indian languages merely with a view to the enjoyment of literature or the understanding of local life and character. But we must not forget that our own scientific nomenclature is chiefly borrowed from dead, inflected languages, and presents difficulties which, to an Indian mind, would not occur in the use of similar phrases borrowed from Sanskrit in the case of Hindu languages or from Arabic for Mohammedan learners of science.

On the whole, in spite of war and other lets and hindrances, some permanent, some, we hope, temporary, Mr. Sharp's admirably arranged and very valuable report tells us a tale of substantial progress. *E pur si muove!* Public expenditure on education has increased by one-half in the five years under review. There is a steady improvement in the number of boys and girls under instruction. Teachers are better paid, though it is probable that much of their increased salaries has been swallowed up by rising prices. The huge, too huge, examining universities are gradually being supplemented by smaller residential and teaching colleges. This change implies some recognition, on the part of Government and parents alike, of the fact that education comprises a moulding of character and will as well as the training of memory, intelligence, and interest.

It is perhaps a little surprising that Government reports on education do not deal with the significant results of school and university teaching as these appear in vernacular literature and journalism. Most of us in Europe have heard of Rabindranath Tagore and one or two other contemporary Indian authors. There are others, locally held in equal, or almost equal, esteem. A system of education which produces really fine literature, much of it entailing solid research and thought in history, in philosophy, and, to a growing extent, in science, is probably more full of hope and promise than can well be shown in an official summary of the educational doings of some 200 millions of human beings of extraordinarily various degrees of social, religious, and scientific progress. This, of course, will be sufficiently apparent to any careful and disinterested reader of Mr. Sharp's admirable report.

[1] "Seventh Quinquennial Review of the Progress of Education in India." By H. Sharp. (Bureau of Education, India.) Price 5s. 6d. net.

NOTES.

THE Board of Agriculture and Fisheries has taken a step long overdue, and now the one competent entomologist on its permanent staff can look forward to assistance in doing the work which twenty competent entomologists might, perhaps, be expected to perform. An entomological laboratory has been established and placed at Rothamsted, where a chief entomologist and two research assistants are to devote their whole time to investigation. The further proposal to appoint twelve advisory entomologists for the twelve agricultural divisions of England is one the advantages of which are doubted in a leading article in the *Times* of October 10. It would be better, our contemporary thinks, "were the research staff at Rothamsted to be increased, and arrangements made for the investigators to visit, now Cornwall, now Northumberland, wherever a local problem became urgent, returning to their headquarters to pool their experience and their results." Research is needed, very much needed, and probably nowhere else in England could greater facilities for investigations of the kind required be found than those at Rothamsted. But if the practical value of entomological research is to be brought home to the farmer, the fruit grower, or the breeder of stock, he must have his eyes opened for him and be given instruction on the spot; it can never be attained simply by the distribution of pamphlets or journals, no matter how well prepared or how valuable the advice they may give. The divisional entomologists should do something more than give advice when called upon; they might make periodical inspections, and have a look out for incipient stages in the diseases of crops in their divisions, as well as for critical stages, so that means could be taken in time to prevent the spread of the disease. It should also be their duty, rather than directly that of the farmer, to keep in touch with what was going on at headquarters, and to become acquainted with all the latest discoveries brought about by research. Even in research they themselves need not be idle, if they have been properly trained, and are qualified, as they should be, to carry it on.

THE annual exhibition of the Royal Photographic Society is again held at 35 Russell Square, as, owing to the requirements of the Government, none of the larger galleries are available. But the scientific section suffers nothing on this account, as the society in its own house has greater facilities for displaying the exhibits. This section fully maintains its reputation. There are forty-three colour transparencies on autochrome plates out of a total of forty-six, but this kind of work is now so well established and so perfect that the interest has passed to the subject rather than to the process. Photomicrography is well represented by entomological and botanical series. A photomicrograph that stands alone must have something very remarkable indeed about it to justify its exhibition. The radiographs of surgical and medical interest are as numerous and valuable as ever, and the application of Röntgen rays to the detection of hidden defects in metal castings and in aeroplane parts is strikingly and beautifully illustrated. Concerning novelties in scientific methods and apparatus, the splendid exhibit of grainless and filmless photography by the Messrs. Rheinberg richly deserves the medal awarded to it. It includes scales on glass for apparently every conceivable purpose, from micrometer scales to scales 30 cm. long. Messrs. Adam Hilger show a spectrograph on an improved Schumann plate which records lines from wave-lengths 21 to 67, and photographs that illustrate the use of the interferometer for testing camera-lenses. The exhibition closes at the end of November.

THE subject of the declining birth-rate was raised at the Church Congress on October 15 in two papers. The Bishop of Birmingham held that restriction of births was due in most cases to prudential motives and to a sense of responsibility, and noted as a curious fact that statistics showed that doctors and clergy, who used to be very prolific, now had smaller families on the average than other people. The nation wants more children, but wants them of the best quality. There must be cases where some kind of control should be exercised, and that must be before conception is known to have taken place. Dr. Amand Routh directed attention to parental syphilis and alcoholism as causes of ante-natal and neo-natal disease and death. He condemned the circulation of so-called "prophylactic packets" as likely to increase rather than to diminish venereal disease. He stated that in the six months ended March 31 last deaths in England and Wales exceeded births by 126,445—for the first time in our statistical history. Dr. Stevenson, Superintendent of Statistics, attributed this to a decline in fertility. Dr. Letitia Fairfield stated that venereal diseases had not only spread during the war, but had rapidly increased since the armistice, and urged an addition to the number of clinics. The Archbishop of Canterbury considered that the use of prophylactics would be perilous as smoothing the way towards vice, but approved the efforts of the National Committee for the Prevention of Venereal Diseases.

IT is with sincere pleasure that we learn that M. Emmanuel de Margerie has been appointed Director of the new Geological Survey of Alsace and Lorraine. M. de Margerie brings to his official duties the knowledge gained by years of cultured conference with geologists throughout the world, and we are indebted to his wide reading and his personal acquaintance with the face of the earth for the French edition of Suess's "Antlitz der Erde." This, far from being a mere translation, is the form in which the book will live as a monument to Austrian powers of collation and construction and to French lucidity of exposition. M. de Margerie's published work has been geographical as well as geological, and it is pleasant to picture him as looking out from the heights of the Vosges on river-profiles once more associated with France. Many questions of economic geology, and therefore of national welfare, will come before him in the recovered provinces. While his sympathetic spirit will find no barrier in the Rhine, his vindication of the attitude of the Entente Powers, addressed during the war to Prof. Heim of Zürich, proves him to be the right man for the task of reconstruction on the frontier.

MR. FRANCIS JEFFREY BELL, who has just retired from the Natural History Museum under the age-limit, entered the service of the trustees on August 12, 1878, when the Zoological Department was still at Bloomsbury and Prof. Owen the superintendent. He took an active part in the removal of the collections to South Kensington in 1882–83, and concerned himself with various divisions of the marine invertebrata, giving especial care to the exhibition of selected types. Mr. Bell is emeritus professor of comparative anatomy in King's College, London, and he served for many years as one of the secretaries of the Royal Microscopical Society, the Journal of which he also edited. In 1898 he acted as general secretary of the International Congress of Zoology, and for many years was a constant attendant at the council of the Marine Biological Association. Mr. Bell is part editor of the Museum report on the collections of the

Southern Cross, and he has seen all six volumes of the *Discovery* Antarctic report through the press.

WE learn from *Science* that Mr. John D. Rockefeller has given to the General Education Board, founded by him in 1902, twenty million dollars, the income of which is to be currently used and the entire principal to be distributed within fifty years for the improvement of medical education in the United States. The working capital previous to this accretion amounted to between 35,000,000 and 40,000,000 dollars. Since the present sum is to be devoted exclusively to medical education, whereas the board's previous resources, under the terms of the charter granted to it by Congress, have been devoted to "promoting education within the United States, without distinction of race, creed, or sex," the activities of the organisation with respect to medical teaching will be greatly increased.

ACCORDING to the *Morning Post*, the Norwegian traveller, Dr. O. Olsen, proposes to conduct a small anthropological and botanical expedition to Siberia next spring. Dr. Olsen has had previous experience in Siberia when in 1914 he studied the Soyot tribes in southern Transbaikalia, near the Kitoisk Mountains. His present project is to go to the Yenisei valley north of Krasnoyarsk, and to push thence into the less known regions immediately to the east, with the object of studying several little-known tribes. These include the Dolgans, a Yakut tribe living between the Yenisei and the Khatanga; certain races of Samoyedes; and certain tribes of Tungus. The expedition also proposes to bring back with it, about January, 1921, seeds of Siberian conifers suitable for planting in Norway.

WE have received a copy of the "Annuaire de l'observatoire royal de Belgique" for 1920, edited by M. G. Lecointe. We are glad to note that the publication of this useful little annual was continued throughout the years of the German occupation of Belgium. The observatory at Uccle was held by the Germans, but its scientific work continued. There was no interruption in its publications, and even research did not completely cease. Needless to say, the Belgian staff was responsible for this continuous activity, M. Stroobant replacing for the time M. Lecointe, who was with the Belgian Army.

THE assistant secretary of the British Association, Mr. O. J. R. Howarth, has been charged with the collection of materials for a history of the association. The records available in the office, especially those referring to the foundation of the association, are far from exhaustive, and the loan of any letters or other documents bearing upon the history of the association will be gratefully welcomed by Mr. Howarth at the office of the association, Burlington House, W.1, and they will be duly returned after use.

THE Secretary of the Department of Scientific and Industrial Research informs us that the following research associations have been formed in accordance with the Government scheme for the encouragement of industrial research:—British Rubber and Tyre Manufacturers' Research Association (c/o Messrs. W. B. Peat and Co., 11 Ironmonger Lane, E.C.2) and the Linen Industry Research Association (secretary, Miss M. K. E. Allen, 3 Bedford Street, Belfast).

THE council of the Chemical Society has arranged for the delivery of three lectures during the coming session dealing with the work accomplished by chemists during the war. The first of these will be delivered at Burlington House on December 18 at 8 p.m. by Prof. James Walker, who will lecture on "War Experiences in the Manufacture of Nitric Acid and the Recovery of Nitrous Fumes."

THE council of the Ray Society has appointed Dr. W. T. Calman, of the Zoological Department, British Museum (Natural History), to be secretary in succession to the late Mr. John Hopkinson.

THE annual report for 1918 on the Forest Administration of Nigeria shows the number of forest reserves to be gradually increasing. Their total area now amounts approximately to 1462 square miles in the Southern Provinces and to 3965 square miles in the Northern Provinces. Plantations continue to be made, in spite of the greatly depleted European staff and the disorganisation caused by the influenza epidemic. Apart from mahogany and *Albizzia lebbek*, the species that have proved most successful are *Cassia siamea*, *Dalbergia sissoo*, *Grevillia robusta*, and *Melaleuca leucodendron*, all of them exotics. In fact, it is very probable that, as experienced in South Africa, the planting difficulty in the Northern Provinces will be solved only by the introduction of suitable exotics. Hence these operations must, for some years to come, be of an experimental nature.

A NUMBER of papers dealing with marine biological and fishery subjects have recently been published. The Danish series, "Meddelelser fra Kommissionen for Havundersogelser," contains articles on purely fishery, hydrographic, and biological investigations. A very useful account of the North Atlantic halibut fishery, including work on the biology of the species, as well as on its exploitation by fishing vessels, is given by P. Jespersen in Bd. v. (No. 5) of the Fishery Series, and a very interesting paper by A. C. Johansen in the same series deals with the biometrics of the spring-spawning herrings that form the bulk of the fish caught during the great spring and summer fisheries. There is also an account of fish-marking experiments carried out on the Faröese fishing grounds. This is local in its scope, but it is interesting to see, from the results, to what an extent this region must have been exploited by British trawlers in the years immediately preceding the war.

IN Report No. 4 of the Industrial Fatigue Research Board Mr. Major Greenwood discusses "The Incidence of Industrial Accidents upon Individuals, with Special Reference to Multiple Accidents." As a result of an elaborate mathematical analysis of a large mass of statistical data, Mr. Greenwood comes to the conclusion that the distribution of accidents among the employees at a factory is by no means a matter of chance, but that certain individuals are much more liable to accidents than others. This susceptibility to accidents is not due to the workers being quicker at their job than their fellows, nor do they differ from them appreciably in general health. It seems to be a matter of personality, and not determined by any obvious extrinsic factor. As Mr. Greenwood points out, the weeding-out of these specially susceptible individuals would lower the average accident-rate of a factory considerably, and it might, in certain instances, have a more important effect than this. In some industries, such as certain of the explosive-supply trades, an accident may lead to frightful disaster, and it might be well worth while to track down these unsafe people by a study of the ambulance-room records and get them transferred to a less risky industry.

THE limitation of human settlement in South Africa through deficient water-supply has moved Prof. E. H. L. Schwarz to undertake a journey to Ovambo-

land, a little-known district north-west of the Kalahari region, which seems threatened by the desiccation that has overtaken the country to the south. In a paper entitled "The Kalahari Lake Scheme" (*S. African Mining and Engineering Journal*—the complete reference is not given on the separate copy sent us), Prof. Schwarz proposes to save Ovamboland and its native population by damming the Cunene River at the cataracts and diverting the water that now flows into the Atlantic back into a depression known as the Etosha Pan. Hence irrigation could be arranged northwards and eastwards. A "Makarikari Lake" is also proposed as a development of the Soa Pan, west of Bulawayo, and from this irrigation might be possible in the eastern Kalahari down the channels of streams flowing to the Orange River. The scheme is already exciting discussion in the States of the Union.

IN a recently published memoir of the Carnegie Institution of Washington (No. 285), Prof. T. H. Morgan gives an account of his experiments relating to the secondary sexual characters of poultry, and discusses at some length the genetic and operative evidence with regard to secondary sexual characters in general. In some breeds of poultry, notably Sebright bantams, the cocks are feathered like the hens, lacking the long, silky hackles of the neck and saddle, and the curved sickle feathers in the tail that distinguish the cocks of normal breeds. Prof. Morgan demonstrates by crossing experiments with game bantams—a breed with the normal sexual differences of feathering in the cock—that the hen-feathered condition is dominant. His figures suggest that two factors are concerned, but the experiments are not sufficiently extensive to render this certain. Castration experiments were performed on the Sebright cocks and some of their hen-feathered progeny, and the interesting fact was disclosed that removal of the testes results in the male assuming a type of plumage characteristic of the cocks of normal breeds. The fact is of great interest in connection with the recent work of Goodale, who showed that removal of the ovary from the hen leads to the assumption of the male plumage. A further point of interest lay in the demonstration of luteal cells in the testes of hen-feathered cocks, similar to those which are known to occur in the ovary of normal hens. Cells of this type are stated to be absent from the testes of normal cocks. The greater part of the memoir is taken up with a discussion of secondary sexual characters in animals generally, in relation both to Darwin's hypothesis of sexual selection, and to the many other views which have been put forward at various times since. A brief review is also given of the heredity of the colour of the plumage in domestic fowls. The memoir contains an ample and useful bibliography, and is well illustrated with coloured and other plates.

THE economic value of the forests of New Zealand is discussed by Mr. D. E. Hutchins in the Transactions of the Royal Scottish Arboricultural Society (vol. xxxiii., part 2, July, 1919). The forests are of great value, and admittedly the best soft-wood forests in the southern hemisphere. In quality New Zealand timbers come before those of Europe and Australia and after those of North America. The valuable kauri-pine (*Agathis australis*) is the largest timber-producing tree in the world, owing to its massive bole having little or no taper. At one time there were about three million acres of kauri forest in New Zealand, now reduced to about half a million, in the extreme north. The next most valuable timber is supplied by another conifer, Totara (*Podocarpus totara*); it is very durable and of a fine colour. This tree is generally distributed through the North and South Islands. A third conifer, Rimu (*Dacrydium cupressinum*), also abundant throughout the islands, is the common house-building timber, a deep red, strong, hard, and heavy wood. White pine (*Podocarpus dacrydioides*), one of the tallest trees in the colony (the writer records one of 210 ft.), has white, easily worked timber suitable for inside work. Honeysuckle (*Knightia excelsa*), a tall, handsome tree with beautifully variegated wood, has never been exported. There is a large class of so-called secondary timbers in New Zealand forests which have never been utilised. The writer deplores the destruction of forests without any attempt to discriminate between land best suited for farming and land best suited for forestry. In 1886 the forest area of New Zealand was estimated at 21,000,000 acres, which by 1909 had become reduced to about 17,000,000 acres. The forests even in their present reduced and neglected condition are worth more than all the known mineral wealth of New Zealand, and they still offer more employment than any other industry. Compared with sheep-farming, the New Zealand forest, if worked as are forests in Europe, would afford about ten times the employment.

IN the *Indian Forester* for July last, Mr. H. H. Haines gives an elaborate description, with figures, of the various shrubs belonging to the genus Carissa, the bark and leaves of which are an important source of tannin. Thirteen species have been described by various authors, but these are reduced by Mr. Haines to five distinct species with several varieties.

MR. ALEX. L. HOWARD wrote some time ago in the *Timber Trades Journal* a series of short articles giving a popular description of the most important woods that are imported into London from India, with notes upon their properties and uses in this country. These articles are now issued by Messrs. W. Rider and Son in pamphlet form, entitled "The Timbers of India" (pp. 16, quarto, price 2*s.* 6*d.*).

IN the description which appeared in NATURE of October 9 of the aurora of October 1, and the simultaneous magnetic storm, several observations were recorded, but unfortunately the time reckoning is not the same throughout. The observations described in the first and last paragraphs were received from the Meteorological Office, and the times mentioned in them were all referred to the civil day, which runs from midnight to midnight, whereas in the other paragraphs describing observations at Bristol and in the Isle of Man the astronomical "day" seems to have been used. When the change of time reckoning to which astronomers have agreed comes into force, the risk of similar accidents will be obviated.

SIR ROBERT HADFIELD has just issued copies of a Foreword which he prepared on the occasion of the Prime Minister's recent visit to Messrs. Hadfield's works at Sheffield. Sir Robert has some timely remarks on the labour situation in the country and the extreme necessity for joint intelligent effort on the part of capital and labour, without which understanding the burden of debt arising from the war cannot be wiped out. During the present year many hundreds of valuable working hours have been lost as the result of trade disputes; but it is really hard to see what can be done without increased enlightenment of the working classes, whose destinies may be said largely to rest with themselves. Sir Robert pleads for the revision of the existing patent laws in this country, so that all classes, without distinction, may benefit from the fruit of their discoveries.

Some space is devoted to the importance of inventions and research in connection with war munitions, and it is interesting to note that Sir Robert's firm is now in a position to manufacture a heavy calibre naval shell which, for range and piercing power, will far outstrip anything previously accomplished. Invention should be stimulated and every effort made to discover fresh inventors, and, once they are discovered, to encourage them to give their ideas to the world so that everyone may benefit from them.

CONSIDERABLE interest is attached to the description in *Engineering* for October 10 of the geared turbines supplied by the De Laval Steam Turbine Co. to the Swedish destroyers *Wrangel* and *Wachtmeister*. The high- and low-pressure turbines occupy separate casings, and drive pinions engaging on opposite sides of the main gear wheel. The high-pressure turbine casing accommodates a cruising element, and the low-pressure turbine an astern turbine. The wheels of both high- and low-pressure turbines are designed to make 3600 revs. per min. at full power, and the maximum peripheral speed is 180 metres per second. The cruising element consists of one velocity-compounded wheel, followed by a simple impulse wheel. The main turbine has four wheels. The astern turbine has one velocity-compounded wheel with two rows of blading, followed by a simple impulse wheel. The aggregate shaft horse-power at full power is 11,000, with the propellers running at 450; the astern shaft horse-power is 4400, with propellers running at 250. With steam 97 per cent. dry, the turbines were guaranteed to consume not more than 5·2 kg. of steam per shaft horse-power hour at full load. Double helical gear wheels are used for speed reduction, and the pinions are rigidly mounted. The pitch line speed at full power is 35 metres per second. Michel thrust-blocks have been fitted, and their remarkable qualities confirmed by the tests.

OUR ASTRONOMICAL COLUMN.

NOVÆ.—Yet another nova has been found on the Harvard plates, this time by Miss Woods (Harvard Bulletin 693). Position for 1875: R.A. 18h. 24m. 6·2s., S. declination 29° 28·9′. Its former magnitude was 14, but it rose temporarily to 11 in 1901. On April 24, 1919, it rose to 7, and has now sunk again to 12, its image appearing nebulous. The magnitudes are photographic.

Pubs. Ast. Soc. Pac., August, 1919, contains a paper by Dr. Shapley on a nova of another kind that was discovered by Prof. Wolf two years ago, and independently by Prof. Barnard in the present year. Its place for 1917·0 is R.A. 17h. 35m. 13·45s., S. declination 11° 53′ 57·6″; its photographic magnitude is 11 (Harvard scale); spectral type, FO; radial velocity large and positive. All plates exposed before 1909 fail to show it; all since 1910 show it. Three interpretations are suggested:—(1) That it is really just beginning its stellar career, in which case it is of unique interest; (2) that it is a long-period or irregular variable, somewhat like η Argûs; and (3) that it has just emerged from behind an obscuring nebula. To test this last suggestion, Dr. Shapley took a long exposure with the 60-in. reflector and studied the distribution of faint stars. The results, given in the paper, while not inconsistent with the hypothesis, give no decisive evidence in its favour; there is no distinct line of demarcation of stellar density, as in some of Prof. Barnard's dark nebular regions. However, a much smaller cloud than these would suffice in this case.

Mr. Joy has made an estimate of the star's distance by the Adams spectroscopic method, finding 500 parsecs. A Harvard plate of 1909 July 9 shows it of magnitude 14·4; 1910 March 21, 11·3. Since 1915 it has been 11.

Both Mr. C. P. Olivier (*Ast. Journ.*, No. 757) and Messrs. Van Maanen and Sanford (Pubs. Ast. Soc. Pac., August, 1919) publish preliminary values of the parallax of Nova Aquilæ 1918. Their values (absolute parallax) are 0·060″ and 0·009″. The latter, which implies a distance of 362 light-years, is close to the values found for Nova Persei, both by direct measures and by the expanding nebular illumination. All the observers contemplate further measures when the brightness of the nova has sunk nearly to that of the comparison stars.

THE SUN-SPOT CURVE.—Mr. Seth B. Nicholson gives an interesting curve of sun-spot activity in Pubs. Ast. Soc. Pac., August, 1919. It is constructed simply from the number of spots, regardless of area. Mr. Nicholson places the late maximum in September, 1917, and the curve since then shows a notable decline. The previous maximum is placed in May, 1905, and is both flatter and lower than the recent one. The minimum is shown in June, 1913. There are also curves of the mean latitude of spots, which show that the fall in latitude since the last minimum has been much steeper than in the preceding cycle.

Mr. Nicholson directs attention once more to the resemblance of the spot-activity curve with the light-curve of Cepheid variables. The sun's surface is certainly not pulsating, as those of the Cepheids are believed to be; if the resemblance of curve means anything, it suggests that there may still be remnants of pulsation in the sun's interior.

SOLAR RADIATION.—Mr. C. G. Abbot (Proc. Nat. Acad. Sci., U.S.A., September, 1919) gives an account of the simultaneous measures of solar radiation made in 1918 at Mount Wilson and Calama, Chile. The results give still stronger support to the hypothesis that the short-period variations in the radiation are in the sun itself than did those at Mount Wilson and Algeria in 1911–12. Mr. Abbot states that the Calama results are telegraphed to Argentina, and successful predictions of temperature are based upon them. He suggests additional radiation stations at various cloudless regions, which he anticipates would be of great utility in weather prediction.

NEW SOURCES OF ALUMINIUM IN NORWAY.

DURING the war neutral as well as belligerent countries had to search within their own borders for those raw materials which formerly they were content to import; new occurrences of well-known ores have been discovered, and new methods devised for winning important products from rocks which hitherto have possessed no commercial value. Norway was particularly hard hit by the curtailment of international trade, and, amongst other problems, that of finding a home source of aluminium presented itself, and seems to have received a promising solution.

The metal aluminium can be obtained by electrolytic means from its oxide, and nearly all the suggested methods of manufacture depend upon this as a final stage, the main difficulty being the preparation of a sufficiently pure oxide, free from iron and silica. The ore commonly used is bauxite, after a rather costly preliminary purification by the Baeyer process. At the outbreak of war the Central Powers

utilised their available bauxite, including the small deposits of poor quality in Germany; but the necessity of finding a more widespread source was felt, and a process was discovered and successfully put into operation by Dr. Buchner, of Heidelberg, for winning the metal from kaolin and kaolin-rich clays. Clay is extracted with sulphuric acid, and, after removal of the iron, the alumina is precipitated from the solution with ammonia, four tons of a clay with an alumina content of 30 per cent. yielding one ton of the oxide. This process seems to have a considerable future before it, and plans are laid for its introduction on a large scale into Sweden.

There is no bauxite in Norway, and it was first proposed to work the clays after the Buchner and other suggested methods. This, however, has for the most part proved impracticable owing to the unfavourable character of the clays, which are relatively unweathered glacial deposits, not only poor in alumina, 16–20 per cent., but with part of it bound in alkali felspar, and therefore unavailable. In 1917 Prof. V. M. Goldschmidt, of the Mineralogical Institute, Kristiania, conceived the idea of using labrador-stone as a source of aluminium.[1] Labrador-stone is a white rock extensively developed in south-western Norway, and especially in the inner Sognefjord district, where it builds the huge laccolitic mountain masses so familiar to tourists, by whom it is commonly mistaken for marble. The main constituent of this rock is a plagioclase felspar of the labrador group, the more felspathic varieties containing only a very small amount of iron-bearing pyroxenes, and with an alumina content of 30 per cent. Prof. Goldschmidt has found that the felspar is surprisingly soluble in dilute acids, so that it can be dissolved out, leaving a residue of insoluble ferro-magnesian minerals and silica. The calcium and sodium oxides of the felspar, 13 per cent. and 5 per cent. in amount respectively, go into solution with the alumina, and, using sulphuric acid, there is thus a considerable loss in the form of a useless by-product. This method is rejected for the manufacture of alumina, although it is used in the preparation of sufficient quantities of aluminium sulphate to satisfy Norwegian needs. By using nitric acid as a solvent, not only is a waste of acid avoided, but the precipitation with ammonia can be dispensed with—a valuable consideration in Norway, where ammonia cannot be obtained cheaply in quantity.

The main features of the process, which has been worked out by Prof. H. Goldschmidt, are as follows: —The labrador-stone is extracted with dilute nitric acid, the 30 per cent. acid, first raw product of the electrical air-industry, serving for this purpose. The silica and greater proportion of the iron minerals remain insoluble, aluminium, calcium, and sodium going into solution together with a little iron. After removal of this iron the solution is evaporated down and the residue heated to a certain temperature at which the aluminium salt alone is decomposed, the nitric acid driven off being collected as a valuable concentrate. By washing with water the nitrates of calcium and sodium are removed, to be recovered and used in agriculture, the alumina remaining.

This process seems to be full of promise for Norway —a country with such abundant water-power, a flourishing nitric acid industry, and an unlimited quantity of a raw material which few other countries possess; and hopes are entertained that a product will be obtained which will not only suffice for local needs, but also win a footing in the world's rapidly expanding aluminium market. L. HAWKES.

[1] "Om Aluminiumfremstilling av Norske Raastoffer." By V. M. Goldschmidt. Særtryk av Tidsskrift. for Kemi, No. 2, 1919.

HYDRO-ELECTRIC DEVELOPMENT WORKS.[1]

AN extremely able and informative paper has recently been contributed to the Institution of Electrical Engineers by Mr. J. W. Meares, chief engineer of the Hydroelectric Service of India, dealing with the general principles of the development and storage of water for electrical purposes—a subject which is of the greatest interest at the present time from an industrial and economic point of view. Mr. Meares's paper is a general survey of the various problems connected with the inception of hydro-electric installations; it outlines the conditions essential to the satisfactory development of any scheme of water-power, for it must, of course, be borne in mind that it is quite possible for a country to have considerable water resources, say, in the form of rivers, which are incapable of economical development. The paper treats of all the preliminary considerations relating to the gathering of supplies, flow and storage, the lay-out and efficiency of hydro-electric plant, and the principles underlying the design of headworks, canals, and delivery mains.

Supplies of water at different heads entail distinct methods of treatment. The heads may be broadly grouped as high, medium, and low, in which, without too rigidly defining the boundary lines, high heads are taken at from 300 ft. or 400 ft. to a possible 5000 ft., low heads from 3 ft. as a minimum to, say, 80 ft. or 100 ft., with medium heads between these limits. A high head is associated with small volumetric flow, and a low head with a large flow; the former is adapted to jet-impulse wheels of the Pelton type, and the latter to pressure, or reaction, turbines.

In areas dependent on the collection of rainfall for supplies, the amount of fall and the run-off are important considerations. The following empirical table devised by Mr. G. T. Barlow, formerly Chief Engineer of the United Provinces, India, gives a working hypothesis for preliminary calculations which, while perhaps inapplicable to many parts of Europe or America, affords a clear indication of the nature of the variations to be met with in a particular locality:—

	Percentage run-off				
	A	B	C	D	E
Light falls, say under 1½″ in 24 hours	1	3	5	10	15
Medium falls, say from 1½″ to 3″ in 24 hours	10	15	20	25	33
Heavy falls, say above 3″ ...	20	33	40	55	70

A is flat, cultivated and black cotton soil catchment.
B is flat, partly cultivated and stiff soils.
C is average catchment.
D is hills and plains, with little cultivation.
E is very hilly, steep, and rocky, with very little cultivation.

The paper also contains a table giving the over-all commercial efficiency of hydro-electric plant as follows:—

For 500 kilowatts	...	...	74 per cent.
,, 1000 ,,	...	...	76 ,, ,,
,, 1500 ,,	...	...	78 ,, ,,
,, 2000 ,,	...	...	80 ,, ,,
,, 3000 ,, and over	...		82 ,, ,,

As a rough approximation, the capacity of plant in kilowatts may be obtained by dividing by 15 the product of the quantity of water in cubic feet per

[1] "The General Principles of the Development and Storage of Water for Electrical Purposes." By J. W. Meares.

second into the head in feet; the b.h.p. of the turbine will be given by one-eleventh of the same product.

The ground covered by the paper is too extensive to admit of adequate notice in the space at disposal. From the foregoing extracts the paper will be seen to be replete with useful information.

BRYSSON CUNNINGHAM.

THE BRITISH ASSOCIATION AT BOURNEMOUTH.

SECTION F.

ECONOMIC SCIENCE AND STATISTICS.

OPENING ADDRESS (ABRIDGED) BY SIR HUGH BELL, BART., D.L., J.P., PRESIDENT OF THE SECTION.

THE cessation of hostilities did not carry with it the cessation of expenditure. The figures given each week in the *Economist* show the daily disbursements of the kingdom to have amounted to 6,500,000*l.* for the twenty-one weeks from November 16 to April 12. Our expenditure from August 24 to November 9 amounted to 585,500,000*l.* From November 23 to July 8 we expended 564,000,000*l.*, a reduction of only 21,500,000*l.*, or about 250,000*l.* a day. The debt with which the war burdened us continued to augment long after the cause of it had ceased to operate. We are still vastly exceeding our income. Even if we take into account the interest on the war debt, which amounts to about 1,000,000*l.* a day, it is clear that the various obligations undertaken by the Government during the war continue to impose on us a huge expenditure which is largely in excess of our revenue.

New claims are made on the national purse and are accepted with the same apparent light-heartedness and disregard of consequences which mark so many previous acts of those responsible for our expenditure both during the war and before it.

The call made on the men and women of the nation for services differing from those to which they had been accustomed involves great changes in the conditions of those affected. Some compensation for these sudden changes was, no doubt, inevitable. The disorganisation of the whole industrial machine made it difficult, if not impossible, to turn these different classes adrift into a world in the chaotic condition into which the war had thrown it. But it does not follow that this compensation should have been given in a way actually to encourage unemployment. There are only too many indications of a general tendency to extravagant expenditure which must be checked before the course of our economic existence can return to normal lines. To enable us to do this we must consider what has happened to the world economically since August, 1914.

The first and perhaps most striking change to be noticed is that in these five years an immense quantity of wealth has been destroyed.

There must be many hundred thousand acres of cultivated land, with the apparatus required for its cultivation, which has been reduced to a state of complete desolation. It is difficult to see how it can be brought again into use at an early date. The mere clearing away of the wire entanglements must be a costly operation. Great quantities of shell abandoned by the Germans in their hasty retreat still cumbered the ground they had occupied. These must be carefully removed—not a very simple operation, and one which must be carried out under skilled direction.

Can anyone doubt the huge destruction of wealth which has occurred? But it is really worse than it appears, for the very process of destruction was even more costly than the damage which was done. Millions of tons of steel in the form of guns and their projectiles—millions of lives had gone to produce this untoward result. For fifty months all the energies of the most active and energetic people on the globe had been turned from beneficial enterprise to work of which the result was the annihilation of vast masses of wealth.

When all these things are considered it is not surprising to find our estimate of the cost of the war reaches a total the mind cannot grasp. When you begin to speak of pounds by thousands of millions, the difference between twenty-five and forty is scarcely noticeable. But be the sum larger or smaller, the all-important fact to be borne in mind is that the wealth which it represents has passed out of being.

So much confusion exists on this subject that it is worth while dwelling on it for a moment. Some contend that there has been a mere change of wealth from one ownership to another. Into whose possession, may we ask, has passed the wealth which used to exist in the towns and villages and cultivated land of the battle area? It is true that the steel which went to effect this destruction has been paid for, but from what source has that payment come? Let us think what might have happened but for the war. The steel might have made rails and been laid on a railway to bring the produce of Central Africa to lands ready to pay for it and desiring to consume it for useful purposes. For all time there would have arisen in the process an income which would have gone to support in comfort those receiving it, and its surplus after this had been effected would have served to add yet more miles of railway and to bring yet more tons of useful produce. All this energy has been dissipated in the manner indicated, and all that remains is the obligation of the "State" for all time to pay interest on a debt which has been created.

There is, as it seems to me, but one way to escape from the situation we have created. No measure of confiscation, however disguised, will remove the burden under which we lie. It may be decided to alter the incidence of the burden from one set of shoulders to another. Any proposal of the kind must have very careful and earnest consideration.

If a really sound and equitable scheme of taxation could be devised, each taxable unit would contribute to the common fund raised for the purpose of the Government an amount which would be arrived at after due allowance was made for his services to the community and his ability to pay. A bachelor, with no claim on him but to support himself without State aid, who had done nothing to provide for a citizen to take his place in the fullness of time, might be called upon to pay more than a man under obligation to maintain a family, and supply, by his children, the means of carrying on the torch of progress.

One of the chief objections of graduation seems to be the danger of gradually increasing the steepness of the scale until the higher incomes would be taxed out of existence and the revenue they produced disappear. This would, no doubt, bring its own remedy. The State needs a certain annual revenue to provide the services demanded by the community. If the result of taking much the greater part of incomes over a certain amount ends by extinguishing these, the State will cease to derive the revenue on which it counts. It must then either reduce the tax on them until a point is reached at which they will continue to exist, or it must increase the tax on all or some of the other incomes. Unless it means to rush headlong into bankruptcy, it must find the point of equilibrium at which its scheme of graduated taxation continues to produce

the revenue required, not in any one year, but in all future years. Such a scheme, could it be discovered, would meet entirely that very important desideratum of a tax, namely, that it should be based on ability to pay.

Two other points must be kept in view. A tax must be equitable in its incidence and reasonably continuous in its imposition. Given these three conditions, the economic burden of the impost will quickly fall on the right shoulders. We may dismiss the argument which asks for a levy on capital, and defends it against the accusation of being confiscatory on the ground that it is no more confiscatory than any other means of raising money by the State. No juggling with the balance-sheets of the nations of the world will get rid of the fact that many thousands of millions of wealth slowly accumulated in the generations which lived before August, 1914, have been dissipated.

[After a brief examination of the changes in the amount of the National Debt for the past century and its gradual reduction since 1814, the address proceeds :—]

In the last five years all this has been changed. From August, 1914, to March, 1915, 450,000,000*l.* were added. The next year added more than 1,000,000,000*l.* By March, 1917, it stood at 3,906,000,000*l.*, and now it has nearly doubled, and is more than ten times what it was at the outbreak of the war.

It is true we have something to set against this vast sum. We have acted as the financial agents of our Allies. The sums we have found for them amount to close on 2,000,000,000*l.* On the other hand, we have ourselves contracted debts abroad to the extent of well on to 1,500,000,000*l.* On balance, therefore, we have interest to receive on about 400,000,000*l.* to 500,000,000*l.* But to enable the inhabitants of this country to find money for our Government, we have sold fully as large an amount of our holdings in foreign securities. It may be contended that we are little worse off. I fear on closer examination this view will not be found good.

Let us admit that our Allies will find no difficulty in paying the 100,000,000*l.* a year or thereabouts due for the interest on their debt to us. We must recognise that this will make a serious draft on their resources. Very different were the securities held by individuals in this country with which they parted to take up each successive issue of Government Bonds at the urgent insistence of successive Chancellors of the Exchequer. The securities sold were usually first-class industrial or public utility issues. What have we got now? A charge on a heavily burdened country of which, it may be, many thousand acres have passed out of cultivation for years to come.

Put at the highest, not many of our millions of pounds will find their own interest. All the balance must come out of the product of the other and real industries of the debtor country, and to this branch of the subject we must now turn.

At the present moment it is of more vital importance than ever that we should come to a clear and unprejudiced understanding on this subject. To judge by appearances, the vaguest opinions exist as to the capacity of the community to meet the various claims which are preferred for a share of the wealth from which alone these claims can be satisfied. Many people seem to think that no demand is too exorbitant. We are asked to provide houses by the hundred thousand, undeterred by the consideration that they will cost two-, three-, or even four-fold the amount at which they could have been built before the war. They are, moreover, to afford accommodation of a much better character than was thought sufficient a very short time ago. Houses built so recently as twenty years ago are no longer good enough for the social reformers of to-day. It is forgotten that something like 80,000 houses are needed each year to accommodate the growth of the population. There are to-day something more than eight million inhabited houses in Great Britain. Not more than half of these are above fifty years old. During the war housebuilding had almost ceased, but before 1914 the building of houses had been checked by two causes. The various Acts of Parliament dealing with matters affecting the building of houses had so enhanced their cost that there was the greatest uncertainty whether houses could be built to return a reasonable interest on their cost.

But the second cause was of as great, or possibly even greater, significance. The trade unions connected with the building trades had gradually succeeded in imposing conditions which had added enormously to the cost of building. It would not be difficult to show why this had been possible, but it would take us too far to follow this line of thought. The fact will not be denied by anyone conversant with the circumstances. The result of all this is a serious shortage of houses, and this it is proposed to make up by grants from the public purse. If this were the only demand of the kind we might face it with more equanimity than is in fact the case. But when we look elsewhere we see other claims comparable in their effects on the public purse, but differing in kind.

The railway enterprise in this country may serve as typical of what is meant. Prior to the war the railways were carrying on their duties in a manner which enabled the country to get through its business in a profitable and, on the whole, fairly satisfactory way. They earned sufficient revenue to pay a fair return to the shareholders. It is true the prospect was not reassuring. The railway management was meeting the usual contradictory claims preferred against almost every industry. It was asserted that they were rendering services which were not nearly so great as were demanded by their customers, and they were charging for them rates which were regarded as quite out of proportion to the value of the services. On the other hand, they were paying wages which the recipients thought entirely inadequate, for much longer hours of service than their workmen were disposed to give. Negotiations between the parties had obtained certain concessions as to hours of work, and also as to rates of pay; but these were not accepted as sufficient, and Parliament was called upon to intervene, with the result that statutory hours were imposed.

The very essential difference between hours of work or rates of pay resulting from convention between the parties interested and the same imposed by statute is often overlooked. The convention can be varied to meet the varying circumstances. The statute provides a hard-and-fast rule, from which it is impossible to depart without incurring penalties.

When the railway companies pointed out the serious effect which these statutory obligations imposed on them had on their revenue-earning capacity, and sought power to increase the rates, their customers were up in arms. The very men who, in Parliament and elsewhere, were applauding the decision to give relief to the railway servants, resolutely refused to pay the extra cost thus incurred. With difficulty was Parliament induced to give the companies leave to add to their charges something towards meeting this cost. The companies found still greater difficulty in obtaining a settlement with their customers as to the amount

which should be so added. The question was still awaiting a final settlement at the outbreak of war.

[The position of the railways is examined; the small yield to the shareholders is set out; the need of the expenditure of fresh capital to enable the companies to cope with the growing traffic is stated; and the address proceeds :—]

There has been a persistent demand by labour throughout the country for better pay, and an equally persistent demand for more leisure. To these demands no objection can be taken. On the contrary, rightly understood, they must meet with approval by all who desire to see the country, as a whole, happy and prosperous. But we must consider how they can be satisfied.

The only source from which satisfaction can be derived is the sum-total of the product of the industry of the country, and indeed of the world, in the period under consideration. It must be noted that in many cases the product may not be realised within that period, as, for example, when a manufacturer holds large stocks of goods which he has not yet marketed, but on which much the greater part of the cost has been paid. It must also be noted that a very considerable part of the industry of the country does not add to the total product which is the subject of division, but is, in fact, a charge on that product. The whole burden is borne by those engaged in providing commodities or services necessary for the members. We touch at this point a very difficult problem, the proper solution of which may possibly show us how all our economic troubles may be ended. I can do no more than state it as briefly as may be.

There can be no question that a very great part of human activities is spent, and the resulting product used, in providing things which cannot be called necessaries of existence. The simplest food, clothing, and shelter may be said to cover all that comes under this head. But life that gives us nothing but the indispensable minimum of these essentials would be so dull and monotonous as to be scarcely worth the exertion needed to procure them. We must have more than these if we are to get enjoyment as well as mere life. How much more can we claim—perhaps we might say, extort—from our environment? And how shall this extra tribute be shared among us?

If we made a complete analysis of the division of the product of industry we should be astonished to find how large is the amount which remains after the essential demands have been satisfied. If we sought to classify our expenditure we might come to some such division as this :—

On essential needs.

On things making for the irreproachable amenities of life.

On luxuries which add to and aid our reasonable enjoyment.

On those which subserve mere pleasures.

On extravagant expenditure for which no justification can be offered.

It is difficult to draw any clear line between the heads of this very rough division. Each class passes imperceptibly into the next. Fortunately for our present purpose, we do not require to do this. It is enough that we should admit that not all activities are well directed, and that we consume a great many things we could do without. No class is exempt from this blame, if blame it be. Each is disposed to look askance at what is called the extravagance of some other. When people talk of waste, they often mean expenditure on things for which they themselves do not care. But the question is: How can we check this extravagance and provide more fully for the more essential needs of the whole people?

If rich men did not drive motor-cars or drink costly wines, would the people who produce these luxuries be better off? Or if, instead of making these things, they made articles needed for the mass of the people, could these buy the result if they had no more means than they now possess? Do we not come back at the end to the proposition that men can have more only if they have more to offer in exchange?

It may be contended that men have obtained more or less completely what they wanted most urgently. They wanted shorter hours. In many trades they have got them, and might have had them in more had they gone about it in the right way. They were not sufficiently desirous of having better houses, and they failed to procure what their well-wishers desired for them.

A relatively small part of the population does unquestionably get a very large share of the total income produced by the whole community. Can we do anything by which this share may be reduced without bringing about greater evils than those we seek to overcome? The history of the sumptuary laws does not encourage much hope that attempts to prevent expenditure in particular directions will have much success. My own studies had brought me, many years ago, to the conclusion that in every industry examined there is no way of giving to those engaged shares greatly differing from what has been afforded in the past. The margins on which manufacture in general is conducted are too small to make it possible to give the larger contributors to the ultimate result any considerable addition to what they have been accustomed to receive. This impression was confirmed by the elaborate general survey of the industry of the kingdom carried out by the Census of Production of 1907.

No doubt labour (which is much the most important item of cost) has obtained a gradually increasing payment, though not necessarily any larger proportionate share. A steady improvement in the methods in which the labour of men is applied has resulted in enabling a larger product to be obtained. Each new implement, each fresh application of energy of various kinds, as, for example, steam and electricity, has meant that the individual man produced more in his day's work, and he got, in fact, a larger return for what he did. But at the same time the capital engaged was increased, and consequently the proportion of the product to be allotted to rewarding capital also increased. It is neither possible nor desirable to attempt to alter this state of things.

The whole question has been treated in a very masterly way by Prof. Bowley in a book published some months ago, entitled "The Division of the Product of Industry." Mr. Herbert G. Williams's pamphlet, entitled "The Nation's Income," also deals with the same subject with much care and skill. In it he makes a critical examination of Sir Leo Chiozza Money's book entitled "Riches and Poverty."

The conclusion reached in these publications is practically the same. It may be stated, in the cautious words with which Mr. Bowley ends his book :—

"This analysis has failed in part of its purpose if it has not shown that the problem of securing the wages, which people rather optimistically believe to be immediately and permanently possible, is to a great extent independent of the question of national and individual ownership unless it is seriously believed that production would increase greatly if the State were sole employer. The wealth of the country, however divided, was insufficient before the war for a general high standard; there is nothing as yet to show

that it will be greater in the future. Hence the most important task—more important immediately than the improvement of the division of the product—incumbent on employers and workmen alike, is to increase the national product, and that without sacrificing leisure and the amenities of life."

I shall have failed in my object if I have left my hearers under the impression that I am wedded to or pleading for any particular division of the wealth of the country. We hear much talk about abstractions called "capital" and "labour." The terms are convenient enough if we do not let ourselves be deluded with the idea that they mean more than the sum of those who own the capital or supply the labour. Labour itself is a somewhat ambiguous term. Until comparatively recently the members of the "labouring classes" so called thought it was synonymous with the man who laboured with his hands. The Labour Party itself has been fain to enlarge its definition so as to include all those who "labour by hand or brain." Not one of us is independent of capital. The most poverty-stricken member of the community relies as implicitly on it as the richest among us. To talk of the "abolition of capital" is to use a form of words which is absolutely meaningless. What most people who use them really mean is one or other of two things, sometimes both at the same time—either that the capital is in the wrong hands and that it should not be held in the way or to the amount which is at present the case, or that the division of the joint product of capital and industry is defective and should be altered.

I see great difficulty in saying no man's fortune shall exceed some given sum, and even in saying no man shall bequeath to his survivors more than some very moderate amount. In either case I should fear endangering that building up of capital which, however it may be divided, is essential to our national progress.

When we come to the division of the joint product of industry and capital other considerations become apparent. The question at once arises whether any other division would have been possible in the past, or could be accomplished in the future, without great changes in the way in which the product arises. Reference has already been made to my own examination of this matter, which leaves me in no doubt that any considerable increase of the part of labour would have left the share of capital so small as to have stifled enterprise.

This does not mean that large fortunes may not have been made by those whose skill and industry and enterprise enabled them to seize the advantages presented to them.

Those who cry out against capital overlook the fact that in modern industries no man can be set to work except by means of a capital sum first found for the purpose. In the industries I know best something above 200*l.* is needed to put a man to work. The population of this country increases at the rate of about 1 per cent. per annum. This means that for every 1000 men to whom employment is being given, about ten youths are ready to be set to work each year, and something above 2000*l.* must be found year by year to give them employment.

One further point must be made. Men see some great enterprise (and the railways will serve very well as an example), and look upon it as a capitalist organisation. But when the circumstances are examined it is found that it consists of a multitude of small holdings, and comparatively few of large amount. In the North-Eastern Railway something like 60,000 shareholders hold the 83,000,000*l.* of capital of various denominations—say, on the average, some 1400*l.* each. Consider the widespread distress which would be caused if the income from the sum were to cease.

I have made a similar calculation for a large colliery undertaking in which I am interested, with the following result. The capital in shares and debentures is about 1,300,000*l.* There are a little more than 1800 shareholders. We employ 5500 men. Each shareholder therefore provides employment for about three men, and holds on the average 725*l.* Before long we shall require further capital. We see our way to enlarge our operations and so to provide employment near to their homes for the fifty to sixty youths who, each year, grow to manhood, and need productive employment if they are not to become burdens on the community. We hope our 1800 shareholders will have laid by enough to provide the 12,000*l.* a year which is necessary for this purpose. We are assuming they or someone will provide it, for we are using our resources (reserves and depreciation funds) in this way, and shortly it will be incumbent on us to fund this obligation and add it to our capital.

We are thus brought to the last subject which I desire to consider with you—the widespread tendency towards what is somewhat vaguely called Nationalisation. It may be questioned whether any large number of people have very clear ideas what is meant by the term.

Let us assume for the present purpose that it signifies that the State shall become the owner of any enterprise which is nationalised—as it owns the business of the Post Office, the Telegraphs, and the Telephones. Let us ask what advantage will be gained by the assumption of ownership. A centralised management, even of so simple a business as that of collecting and distributing letters and parcels, has not been an unqualified success. Where the business is more complicated, as in the other examples, the success has been even less conspicuous. What reason have we to hope, then, in such intricate matters as the railways or the mines, better results will follow?

The incentive of individual gain will have disappeared, and with it the readiness to accept such risks as those to which reference has already been made. We may easily find that the developments needed to find employment for our young people are not forthcoming, for without such risks being run no growth of employment will take place. Unless I am much mistaken, a great temptation will be put before politicians to make concessions to the huge army of voters who will be in the direct employment of the Government.

The experience of these five years has failed to teach the lesson that you cannot touch one branch of labour without affecting all others. An advance of wages given to one section will inevitably be demanded by all others. The result will be prejudicial to the whole community. As regards international trade, we may find ourselves shut out of foreign markets because our wages are made artificially high, just as we should be excluded if, for example, the shipowners could compel us to pay inordinate freights on some indispensable raw material like cotton.

A cure will speedily come, but it may come after great suffering has been inflicted on the whole community. Parliament can easily impose on the employer, whether a private individual or the State, the payment of a certain wage if a man is employed, but one thing it cannot do, and that is compel the employment of the man at a wage which the price of the article he produces will not suffice to pay. The man will remain unemployed. That is the drastic remedy which economic law imposes. We may escape it by making up from some other source the deficiency

if we insist on having the article and refuse to pay the cost. But this remedy is applicable only to some small part of our total product. When we come to such industries as those now talked of it is impossible. We must make the industry self-contained.

But it may be said that those most concerned are not striving alone, or even chiefly, for higher wages, but desire to participate in the management and to bear their part in deciding the questions of policy which up to now have been in the hands of the employers. To this no fundamental objection can be raised. The more completely the men engaged in any enterprise understand it, the better it will probably be for the whole. But large questions of policy require knowledge and appreciation of circumstances which can with difficulty be acquired by persons whose life is necessarily passed in quite other surroundings. That the fullest information should be given to the persons in question cannot be denied. The claim to deal with matters of management lying quite beyond their competence cannot be conceded. The final impulse comes from one mind which cannot divest itself of its responsibility or exercise it under such conditions as those suggested would impose.

A universal unrest pervades the world. This had indeed already become apparent before 1914. The war has exacerbated the symptoms which were already sufficiently menacing. Remedies by legislation had been applied here and elsewhere without success. In the nineteenth century the political emancipation of the inhabitants of this country was gradually effected. By the end of it freedom had been practically won. The great changes which occurred in the political condition of the country as it was before 1832 and as it became by the end of the century had been brought about with relatively little trouble. It is not surprising that this should have led to the conclusion that economic changes could be effected with equal ease. Perhaps the confusion which we continually observe between a "law" imposed by the will of a legislature and a "law of Nature," so called, is responsible for this conclusion.

Having gained political freedom comparatively easily, people seem to have thought economic freedom could be got with equal facility. We have had numerous instances of this on which it is unnecessary to dwell. Concessions have been made by which, apparently, life was made much easier for certain people. But the fund out of which these concessions were to come has not been increased. Many of them, though not so intended, had the effect of positively lessening that total. In a perfect world it ought not to have had this effect, but, human nature being what it is, it was easy to foresee the result. It could have been foretold that a minimum wage established by law would sooner or later reduce the output of the man paid by piece. It had that effect on the coal-miners at a very early date after its enactment.

The demand for higher wages without a corresponding increased output was causing anxiety before the outbreak of war. The inordinate expenditure which the war brought with it seemed to justify the contention of the workmen that the claims they had put forward could easily have been met in the past, and must be conceded when things became normal again. It was forgotten that all thought of economic production had ceased. We were living, not on the earnings of the year, but on credit raised on our expectations of the future. In the past this course was also pursued, but (as has already been pointed out) in very different circumstances, for the capital thus created was calculated to yield an adequate return to the persons interested.

None of the remedies proposed touches the difficulty. We must obtain a larger product if we are to have more to divide. Restrictions in output, whether produced by the act of the Legislature, the will of the worker, or (let us add) the hindrance of a tariff, will fail to effect this. None of the short cuts now proposed will lead us to our goal. Can we convince those most deeply interested of the truth of this? The task is not an easy one, for promises without end are made to accomplish what is desired without pursuing the patient and laborious course which alone can lead to a happy solution. For my part, I rely on the common sense of my fellow-countrymen. The speedy abolition of all artificial prices by which we shall get to know the real cost of what we buy will be a great help. We may hope that on this will follow an earnest desire on the part of all to do their best for the commonweal—convinced that on this intelligent altruism we are best serving our own ends. A better division of industry would ensue. The net result would be a happy and contented nation, in which the efforts of each would be more guided by the common welfare than by the selfish desire for the advantage of the individual.

None of these things can be accomplished by Acts of Parliament. Statutory prices and statutory hours offer no solution—rather increase the evil than lessen it. There is no royal road by which we can travel to a solution. We must, by patience and mutual forbearance, seek to alter the present hostile attitude. We may frankly accept Prof. Cannan's opinion that "the economic organisation of the nineteenth and early twentieth centuries will not endure for ever, but will be gradually replaced by something else more suitable for its own day and generation."[1]

Let all parties in the State bend themselves to this change, in which, again to quote Prof. Cannan, "free associations of free men able to go out and come in as each pleased would voluntarily give service for service, irrespective of domicile and nationality." This is a change which we may agree with him in thinking more "desirable than any restoration of the feudal system basing economic organisation on the territory of the lord, even if the personal lord of the Middle Ages is replaced by a Parliament elected by universal suffrage and proportional representation."[2]

FORTHCOMING BOOKS OF SCIENCE.

SINCE the appearance of the article on "Forthcoming Books of Science" in NATURE of October 16, some further lists of books likely to appear in the near future have reached us. *The Cambridge University Press* is to publish "The Transmutation of Bacteria," Dr. S. Gurney-Dixon, and "Notes on Magnetism," C. G. Lamb. *Messrs. C. Griffin and Co., Ltd.*, announce "The Flow and Measurement of Air and Gas," A. B. Eason; "The Practical Design of Plate Girder Bridges," H. Bird, illustrated; "Marine Diesel Engines: Maintenance and Running," J. Lamb, illustrated; "Laboratory Aids in Practical Mechanics," G. S. Bowling; "Airman's International Dictionary, English–French–Italian–German," Lieut. M. M. Dander; "A Treatise on Surveying and Levelling," S. Threlfall, illustrated; "Modern Mine Valuation," D. Penman, illustrated; "Peat Reference Book," F. T. Gissing; "Coke-Oven and By-Products Works Chemistry," T. B. Smith, illustrated; "Coal Economy: The Reduction of National Coal Consumption by 50 Million Tons a Year," W. H. Casmey; "Analytical Chemistry as a Profession for Women," Emily A. L. Forster; "Text-book of Inorganic Chemistry,"

[1] "Coal Nationalisation," p. 25. [2] *Ibid.*

vol. ix., Cobalt, Nickel, and the Elements of the Platinum Group, Dr. J. Newton Friend, and Iron, Dr. J. Newton Friend and J. Bentley; and new editions of "A Treatise on Petroleum," Sir Boverton Redwood, Bart., in 4 vols.; "Electrical Practice in Collieries," Prof. D. Burns; "The Problem of Flight: A Text-book of Aerial Engineering," H. Chatley; "The Mineralogy of the Rarer Metals," E. Cahen and W. O. Wootton; "Elementary Agricultural Chemistry," H. Ingle; "Dairy Chemistry," H. D. Richmond; "Paper Technology," R. W. Sindall; "Modern Road Construction," F. Wood; "The Physico-Chemical Properties of Steel," Dr. C. A. Edwards; "General Foundry Practice," A. McWilliam and P. Longmuir; "A Medical Handbook." Dr. R. S. Aitchison; "Introduction to the Study of Midwifery," by Dr. A. Donald, illustrated; "A Manual of Elementary Seamanship," D. Wilson-Barker; and "Elementary Coal-Mining," G. L. Kerr. The new list of the *J. B. Lippincott Co.* includes "The Harvey Lectures, Delivered under the Auspices of the Harvey Society of New York, 1917–1919"; "Training of a Pharmacist," D. C. O'Connor, illustrated; "Airplane Photography," Major H. E. Ives, illustrated; "Training for the Electric Railway Business," C. B. Fairchild, illustrated; and "Applied Economic Botany," Prof. M. T. Cook, illustrated. They have also a number of volumes in preparation for appearance in the series of "Monographs on Experimental Biology and General Physiology." *Mr. John Murray* promises "Science and Life: Aberdeen Addresses," Prof. F. Soddy; "Springtime and Other Essays," Sir Francis Darwin; "The Life of Sir William White, K.C.B., F.R.S.," F. Manning, illustrated; "The Shibboleths of Tuberculosis," Dr. M. Paterson; "Theodore Roosevelt's Letters to his Children," edited by J. B. Bishop; "Wild Life in Canada," Capt. A. Buchanan, illustrated; "Homing with the Birds," Gene Stratton-Porter; "Strategic Camouflage: The Probing of a German Secret," S. A. Solomon, illustrated; and a new and enlarged edition of "Microscopy: The Construction, Theory, and Use of the Microscope," E. J. Spitta, illustrated. We notice that Dr. E. A. Wallis Budge's long-expected new book is to be entitled "By Nile and Tigris: A Narrative of Journeys in Egypt and Mesopotamia on Behalf of the British Museum between the Years 1886–1913." It will be in two volumes and illustrated.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BRISTOL.—A new chair of physical chemistry has been established in the University on the endowment of Lord Leverhulme. Capt. J. W. McBain, lecturer in physical chemistry in the University since its foundation, has been appointed to the chair.

OXFORD.—We understand that Prof. S. H. Vines is retiring from the Sherardian professorship of botany in the University at the end of the current year.

SHEFFIELD.—On Friday, October 17, the Prime Minister received an honorary degree at the University, and took the opportunity of speaking on the place which the university, especially the modern university, can fill in the general field of education. He spoke with great cordiality on the function in the educational world of the modern universities, illustrating particularly by the influence which the University of Wales has exercised throughout the entire Principality. He congratulated Sheffield on the progress that it had made, and paid a warm tribute of appreciation to the work of Mr. H. A. L. Fisher, both as Vice-Chancellor of the University and as President of the Board of Education. In particular he spoke of the work done by the applied science department during the whole history of the University, and especially in relation to the supply of munitions for the British Army. "The contribution of Sheffield," the Prime Minister said, "was not merely a contribution drawn from the ranks of its students and its staff on the fighting side. It made a real contribution on the side of the provision of materials—an essential part of the winning of the war." At the same time he pointed out that the work of a modern university was not by any means comprised in the service which it rendered to material needs or to local industries, important as these were; it should be, in addition, the intellectual centre of the whole district in which it was situated. "It leads," he said, "the population which surrounds it to a higher culture; that is the great task of all these young universities; and I am glad to know that Sheffield is thoroughly realising the importance of this aspect of its work, as well as the more and immediately practical part of the enterprise."

THE Salters' Institute of Industrial Chemistry has awarded grants in aid to thirty young persons occupied in chemical factories in or near London to assist them in improving their knowledge of chemistry.

THE estate left by the late Gen. Horace W. Carpentier is valued, says *Science*, at 721,200*l*. The principal beneficiaries are Columbia University and Barnard College, each of which receives 284,000*l*., and the University of California receives 20,000*l*. From the same source we learn that by the will of the late Mr. Charles W. Lenney, of New York, 10,000*l*. is left to Boston University.

THE Rev. S. Graham Brade-Birks has been appointed lecturer in zoology at the South-Eastern Agricultural College, Wye. Mr. Brade-Birks is an honours graduate of the Victoria University of Manchester, and since his ordination in 1914 has spent much of his leisure researching with his wife (Dr. Brade-Birks) on the English millipedes and centipedes. Last session (1918–19) he acted as demonstrator in the zoological laboratories at the University of Manchester.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 22.—M. Léon Guignard in the chair.—The president announced the death of Gustaf Retzius, correspondant for the section of anatomy and zoology.—N. E. **Nörlund**: The polynomials of Bernoulli.—L. B. **Robinson**: A symmetrical system of polynomials.—J. **Chazy**: Solutions of the problem of three bodies where the three bodies form an isosceles triangle.—G. **Sagnac**: The æther and absolute mechanics of waves.—L. **Bruninghaus**: The conditions of production of fluorescence.—J. **Guyot** and L. J. **Simon**: The action of hydrates, oxides, and carbonates of the alkaline earths on dimethyl sulphate. Quicklime and caustic baryta are almost without action upon methyl sulphate; baryta-water and lime-water give barium and calcium methyl sulphates in theoretical quantities. Crystallised barium hydrate or slaked lime with methyl sulphate gives methyl ether and the sulphate of the metal.—M. **Delpech**: Flameless powders. An account of experiments on the effect of adding charcoal, vaseline, and other substances to propellant explosive from the point of view of producing a flameless explosion at the gun. Vaseline and heavy petroleum oil proved to be the most effective, provided

that suitable additions to the weight of the charge were made to make up for the addition of the non-explosive material.—M. **Bourgeat**: The discovery of coal-bearing schists on the borders of the Serre.—E. **Chaput**: Remarks on the origins and classification of Desmoceras.—F. **Morvillez**: The leaf-conductor apparatus in the Hamamelidaceæ and neighbouring forms.—J. **Dufrénoy**: Experimental bacterial tumours in pines. This disease is due to a coccus, and is transmissible from tree to tree. The tumour is caused by a deposit of resin at the infected part.—G. **Bazile**: New methods for the destruction of Acridians. The experiments were carried out in Algeria on columns of *Schistocerca tatarica*. Of the methods tried, the use of flame-projectors proved to be the best.—P. **Godin**: Difference of progression of the index of growth in the male and female sexes.

SYDNEY.

Royal Society of New South Wales, September 3.—Prof. C. E. Fawsitt, president, in the chair.—J. H. **Maiden**: Two new Western Australian species of Eucalyptus. The two species have hitherto been wrongly included in *Eucalyptus Oldfieldii* One is a mallee that was originally collected by the Elder Exploring Expedition in 1891 both in South Australia and in Western Australia. It is now recorded from the Murchison River. It attains a height of about 20 ft., and has a singular, striate bark. The other species grows in damp, sandy land between the Darling Range, south of Perth, and the sea. It is a white gum, and has for many years been confused with the wandoo.—E. **Cheel**: Three new species of Leptospermum. One of the species from North Queensland, collected by Dr. E. Mjoberg during the Swedish Scientific Expedition to the Commonwealth in 1913, has been named *Leptospermum Mjobergi* in honour of the discoverer. The other two species are found chiefly along the south coast of this State, and include a species which somewhat resembles some of our native Epacris. This has been named *Leptospermum epacridioideum*, and the other *L. odoratum* on account of the fragrant oil contained in the leaves.

BOOKS RECEIVED.

Stereochemistry. By Prof. A. W. Stewart. Second edition. Pp. xvi+277. (London: Longmans and Co.) 12*s.* 6*d.* net.

Immunity in Health: The Function of the Tonsils and other Subepithelial Lymphatic Glands in the Bodily Economy. By Prof. K. H. Digby. Pp. viii+130. (London: Henry Frowde and Hodder and Stoughton.) 8*s.* 6*d.* net.

Human Vitality and Efficiency under Prolonged Restricted Diet. By F. G. Benedict, W. R. Miles, P. Roth, and H. M. Smith. Pp. xi+701. (Washington: Carnegie Institution of Washington.)

A Biometric Study of Basal Metabolism in Man. By J. A. Harris and F. G. Benedict. Pp. vi+266. (Washington: Carnegie Institution of Washington.)

The Ecological Relations of Roots. By Prof. J. E. Weaver. Pp. vii+128+30. (Washington: Carnegie Institution of Washington.)

The Carbohydrate Economy of Cacti. By H. A. Spoehr. Pp. 79. (Washington: Carnegie Institution of Washington.)

Orthogenetic Evolution in Pigeons. Posthumous Works of Prof. C. Otis Whitman. Vol. i. Edited by O. Riddle. Pp. x+104+88 plates. (Washington: Carnegie Institution of Washington.)

Inheritance, Fertility, and the Dominance of Sex and Color in Hybrids of Wild Species of Pigeons. Posthumous Works of Prof. C. Otis Whitman. Vol. ii. Edited by O. Riddle. Pp. x+224+39 plates. (Washington: Carnegie Institution of Washington.)

The Behavior of Pigeons. Posthumous Works of Prof. C. Otis Whitman. Vol. iii. Edited by Prof. H. A. Carr. Pp. xi+161. (Washington: Carnegie Institution of Washington.)

Theorie de Strahlung und der Quanten. By Dr. A. March. Pp. vii+182. (Leipzig: J. A. Barth.) 12 marks.

Studies of Heredity in **Rabbits, Rats,** and Mi[illegible]. By W. E. Castle. Pp. iii+56+iii plates. (Washington: Carnegie Institution of Washington.)

A Manual of Physics. By Dr. J. A. Crowther. Pp. xx+537. (London: Henry Frowde and Hodder and Stoughton.) 16*s.* net.

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 24.

PHYSICAL SOCIETY, at 5.—Dr. N. W. McLachlan: The Effect of Pressure and Temperature on a Meter for Measuring the Rate of Flow of a Gas.—J. H. Shaxby: A Cheap and Simple Micro-balance.—J. W. T. Walsh: The Resolution of a Curve into a Number of Exponentials.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Dr. E. Hopkinson: Presidential Address.

TUESDAY, OCTOBER 28.

WIRELESS SOCIETY OF LONDON (at Institution of Civil Engineers), at 6.—General Meeting.

WEDNESDAY, OCTOBER 29.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 8.—Sir Horace Darwin: The Static Head Turn Indicator for Aeroplanes.

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